

TESTING OF CLINICAL THERMOMETERS

Department of Commerce and Labor

BUREAU OF STANDARDS

Washington

BUREAU CIRCULAR NO. 5

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Under the provisions of an act of Congress approved March 3, 1901, establishing the Bureau of Standards, this Bureau is authorized, among other things, to test clinical thermometers used in medicine, surgery, pharmacology, and related scientific work.

PRELIMINARY EXPERIMENTS.

During the past two years the Bureau of Standards has received numerous inquiries concerning the certification of clinical thermometers, from manufacturers and users of these instruments. Before this work could be undertaken it was necessary to make an exhaustive study of the magnitude of the errors and of the most common defects in existing types of thermometers. Accordingly a large number of clinical thermometers of various types and manufacture were carefully studied during the past year as to magnitude of errors, destructibility of index, time of action, difficulty of throwing back index, effect of aging, nature of glass used, etc. These experiments soon disclosed the fact that there was a marked discrepancy in the temperatures indicated by thermometers sent in by different makers, showing a great lack of uniformity in the standards commonly in use in this country. The scale of temperature most commonly used was about 0.2° F. high, and accordingly some of the leading manufacturers of clinical thermometers were requested to submit their standards for verification. The study of these standards confirmed the conclusions drawn from the study of the clinical thermometers.

UNIFORM SCALE OF TEMPERATURE.

The readiness with which manufacturers complied with our request, and the interest they have shown in our work, have been of great assistance to us in this important work of introducing a *uniform scale of temperature*. The standard scale of temperature now in worldwide use is the so-called "international hydrogen scale." The adoption of this scale of temperature by the manufacturers and users of clinical thermometers, besides offering the advantages resulting from a uniform scale in this country, can not fail to be of service where our thermometers are sent abroad and come into competition with those certified by foreign testing bureaus. The satisfactory conclusion to which this work has led is evidenced by the fact that the corrections found for the clinical thermometers that are now sent in by manufacturers who have certified standards are very much smaller than the corrections of those submitted at the beginning of these investigations.

METHODS OF TESTING.

As many manufacturers have expressed a desire to submit thermometers for certification in large numbers, it has been necessary to develop methods of testing that will involve a minimum of time and expense, without in any way sacrificing the desired accuracy. As these methods may be of some service to manufacturers in the construction of thermometers, full details of the apparatus, methods of testing, and the results will be published in the near future in a special bulletin on the testing of clinical thermometers.

NATURE OF TEST.

The testing of clinical thermometers, as carried on at present, consists of two parts—a preliminary examination for defects of construction, such as defective graduation, presence of cracks in the glass, air bubbles in bulb, too great effort required to throw back the index below 95° F., destructibility of index, etc. If a thermometer is defective in any of these respects, it is refused certification. If it successfully passes the preliminary examination, it is then compared at four different temperatures with the standard thermometers of this Bureau, in order to determine the magnitude of the corrections at these four points of the scale. This comparison is carried out at least twice at each temperature. The test points are 96° F., 100° F., 104° F., and 108° F.

LIMITS OF ERROR.

If the magnitude of the corrections at any of the four points tested exceeds 0.3° F. (or 0.15° C.), the thermometer is refused certification. The magnitude of these corrections is determined, as stated above, by taking the mean of at least two independent comparisons with the standards at each test point, and if in any of these experiments a thermometer fails to repeat its reading to within 0.15° F., it will fail to receive a certificate. Furthermore, the maximum error that may arise in the measurement of the temperature interval included between any two consecutive test points must not exceed 0.3° F. (0.15° C.).* These limits of allowable error have been placed somewhat high in order to give ample time for manufacturers to adapt their standards to the standard scale of temperature used by this Bureau. The Bureau of Standards reserves the right at any time to diminish the above limits of allowable error for certification, by giving due notice to manufacturers.

SPACE FOR MARKING.

Every thermometer submitted for test must have a clear space near the top of the stem, at least 2 cm ($\frac{3}{4}$ inch) long, suitable for engraving thereon the identification marks of the Bureau.

CHANGES WITH TIME.

It is of course well known that if thermometers are graduated immediately after being made up in the blast lamp, changes of considerable magnitude in their indications may occur with time. The amount of this change will depend on the composition of the glass, the method of working the glass in the construction of the thermometer, and the time. With reference to the element of time, small changes in the volume of the bulb will take place for many years, but by far the greatest part of the change is found to occur in the first six months after the construction of the thermometer. One of the most important elements entering into the time change of thermometers is, of course, the chemical composition of the glass that is used. If any of the soft English or Thüringen glasses are used that for so many years were the glasses most commonly employed in the construction of thermometers, the time change is extended over a much longer interval before it becomes negligible and may amount to 1° F. or more. If, however, any of the well-known hard thermometric glasses are used, the changes in the indications of a thermometer after the first six months are practically negligible for the purpose of clinical thermometry.

*For example, if the correction for a particular thermometer at the 96° point were +0.3° F., and at the 100° point —0.1°, the error in the value of the temperature interval would be 0.4° F., and the thermometer would fail to receive a certificate.

CERTIFICATES.

The custom has become very general in this country of making the bulbs of clinical thermometers of some of the hard glasses, and the stems of soft glass with white enamel backing. Inasmuch as the volume of the bulb is many times the volume of the stem, the changes in the glass of which the stem is made are entirely negligible, except in so far as they affect the constriction in the stem on which the index depends. The tests carried out by this Bureau seem to show that in some instances, however, thermometers are still made up "green" and out of soft glass. If such thermometers are certified before being sufficiently "seasoned," the certificate becomes practically useless in a few months, and besides doing an injustice to the reliable manufacturer, it assists in perpetuating a false idea of accuracy and defeats the primary objects aimed at in certification, namely, an impartial guarantee, to the manufacturer and user alike, of the thorough reliability of the article. Consequently, in order to protect the integrity of its seal, the Bureau of Standards has decided to issue certificates at an early date under two different conditions, viz, for thermometers that have been sent to us for test and of which we have no official knowledge as to the time that they have been seasoned, and secondly, for thermometers that have been placed under the official seal of this Bureau for a period at least six months preceding the date of test. Under whichever of these conditions a thermometer is submitted, the same form of certificate will be issued, and this certificate will contain the following statement:

"Unless this thermometer has been suitably aged before testing, its indications are liable to change with time. Where thermometers have been placed under the official seal of this Bureau for at least six months preceding date of test, the letter A is engraved on the stem immediately after the B. S. certification No."

For the present, until further facilities can be provided for the aging of thermometers, certification will be issued only under the first condition specified above. Due notice will be given to manufacturers when thermometers may be submitted for aging.

FORM OF CERTIFICATE.

The certificate furnished by the Bureau of Standards will contain the following data:

- (a) Description of article or instrument.
- (b) Bureau of Standards test number, and certification number where allowed.
- (c) Name of party for whom test is made.
- (d) Temperatures at which comparisons are made.
- (e) Other conditions of the test.
- (f) Corrections at each test point.
- (g) Date of certification.
- (h) Seal of the Bureau and the signature of the Director.
- (i) Special remarks where necessary.

FEES.

The following schedule of fees for testing clinical thermometers has been established:

SCHEDULE 35.—CLINICAL THERMOMETERS.

(a) In lots up to 8, each.....	\$0.25
(b) Any number between 8 and 12, total fee.....	2.00
(c) In lots of 1 dozen or over, and less than 4½ dozen, per dozen.....	2.00
(d) Any number between 4½ and 6 dozen, total fee.....	9.00
(e) In lots of 6 dozen or over, per dozen.....	1.50

SHIPPING DIRECTIONS.—Packages intended for this Bureau should be plainly marked "Bureau of Standards, Department of Commerce and Labor, Washington, D. C."

All damages resulting from testing or transportation are at the owner's risk. Every possible precaution, however, is taken to reduce these to a minimum. Packages containing glass or other fragile instruments should be so marked.

Transportation charges on all packages sent to this Bureau must be prepaid, and all packages returned will be sent "charges collect." No package will be returned until the fees due thereon have been received.

S. W. STRATTON,
Director.

Approved:

GEO. B. CORTELYOU,
Secretary.

